I CLAIM:

1. A method for manufacturing an object having a potential $\{x\}$ that is generated in response to a field $\{f\}$ applied thereto, the method comprising the steps of:

generating a computerized mathematical model of the object by discretizing a geometric model of the object into a plurality of finite elements and specifying values for the field $\{f\}$ and potential $\{x\}$ relative to the finite elements;

specifying that the material properties of the finite elements have a particular symmetry;

calculating a material property matrix [k] based on the relationship $\{f\}=[k]\{x\}$ and the specified symmetry;

extracting material property coefficients from the material property matrix [k] for each finite element in the computerized mathematical model;

comparing the extracted material property coefficients to material property coefficients for known materials to match the extracted material property coefficients to the material property coefficients for known materials;

determining manufacturing parameters for controlling manufacturing equipment based on the matched material property coefficients; and

controlling the manufacturing equipment in accordance with the determined manufacturing parameters to thereby manufacture the object.

2. The method according to claim 1, wherein the material properties of the finite elements are specified to be isotropic.

3. The method according to claim 1, wherein the material properties of the finite elements are specified to be transversely isotropic.

4. The method according to claim 1, wherein the step of generating a computerized mathematical model of the object further includes determining the smallest volume increment that can be manufactured using the composite manufacturing equipment.

5. The method according to claim 1, wherein the field {f} is a mechanical force field and the potential {x} is a displacement.

6. The method according to claim 1, wherein the field {f} is an electric current field and the potential {x} is a voltage.

7. The method according to claim 1, wherein the field {f} is a magnetic field and the potential {x} is a magnetic vector potential.

8. The method according to claim 1, wherein the field {f} is a thermal flux field and the potential {x} is a temperature.

9. The method according to claim 1, wherein the field {f} is a fluid velocity field and the potential {x} is a fluid potential.

10. The method according to claim 1, wherein the step of controlling the manufacturing equipment comprises controlling a composite manufacturing equipment for manufacturing a composite material.

11. The method according to claim 10, wherein the composite material comprises structural fibers laminated in a matrix.

12. The method according to claim 11, wherein the matrix includes biologic material.

13. The method according to claim 11, wherein the matrix includes bone.

14. The method according to claim 11, wherein the matrix includes crushed bone.

15. The method according to claim 11, wherein the matrix includes co-factors.

16. The method according to claim 11, wherein the matrix includes biological cells.

17. The method according to claim 11, wherein the matrix includes bio-active materials.

18. The method according to claim 11, wherein the matrix includes medications.

19. The method according to claim 11, wherein the matrix includes antibiotics.

20. The method according to claim 11, wherein the matrix includes radioactive materials.

21. The method according to claim 1, wherein the object being manufactured is a prosthetic implant for replacing a body part and the force {f} and displacement {x} are specified based on the in vivo forces applied to the body part to be replaced and the in vivo displacements generated in the body part to be replaced when the forces are applied thereto.

22. An article of manufacture made in accordance with the method of claim 1, wherein the article is selected from the group consisting of an automobile part, an aircraft part, a prosthetic implant, a golf club shaft, a tennis racket, a bicycle frame, and a fishing pole, and wherein different portions of the article have different material properties.

corresponding to the matched extracted material property coefficients for known materials.

23. A prosthetic implant manufactured in accordance with the method of claim 1.

24. A golf club manufactured in accordance with the method of claim 1.

25. A computer-implemented method for determining machine control instructions for manufacturing an object having a potential $\{x\}$ that is generated in response to a field $\{f\}$ applied thereto, the method comprising the steps of:

generating a computerized mathematical model of the object by discretizing a geometric model of the object into a plurality of finite elements and specifying values of the field $\{f\}$ and potential $\{x\}$ relative to the finite elements;

specifying that the material properties of the finite elements have a particular symmetry;

calculating a material property matrix $[k]$ based on the relationship $\{f\}=[k]\{x\}$ and the specified symmetry;

extracting material property coefficients from the material property matrix $[k]$ for each finite element in the computerized mathematical model;

comparing the extracted material property coefficients to material property coefficients for known materials to match the extracted material property coefficients to the material property coefficients for known materials;

determining manufacturing parameters for controlling manufacturing equipment based on the matched material property coefficients; and

generating machine control instructions for controlling the manufacturing equipment in accordance with the manufacturing parameters.

26. The method according to claim 25, wherein the object being manufactured is a prosthetic implant for replacing a body part and the force {f} and displacement {x} are specified based on the in vivo forces applied to the body part to be replaced and the in vivo displacements generated in the body part to be replaced when the forces are applied thereto.

27. The method according to claim 25, wherein the step of generating machine control instructions comprises generating machine control instructions for controlling composite manufacturing equipment for manufacturing a composite material.

28. The method according to claim 27, wherein the composite material comprises structural fibers laminated in a matrix.

29. The method according to claim 28, wherein the matrix includes biologic material.

30. The method according to claim 28, wherein the matrix includes bone.

31. The method according to claim 28, wherein the matrix includes crushed bone.

32. The method according to claim 28, wherein the matrix includes co-factors.

33. The method according to claim 28, wherein the matrix includes biological cells.

34. The method according to claim 28, wherein the matrix includes bio-active materials.

35. The method according to claim 28, wherein the matrix includes medications.

36. The method according to claim 28, wherein the matrix includes antibiotics.

37. The method according to claim 28, wherein the matrix includes radioactive materials.

38. A computer system programmed to perform the method of claim 25.

39. A control system programmed with machine control instructions for controlling composite manufacturing equipment to manufacture a composite object, wherein the machine control instructions are generated in accordance with the method of claim 25.

40. Composite manufacturing equipment comprising a control system programmed with machine control instructions for controlling the composite manufacturing equipment to manufacture a composite object, wherein the machine control instructions are generated in accordance with the method of claim 25.

41. A method for manufacturing an object for which a defined field {f} generates a potential {x} in response thereto, the method comprising the steps of:

(1) generating a computerized mathematical model of the object by discretizing a geometric model of the object into a plurality of finite elements;

(2) specifying values of the field {f} and the potential {x} relative to the finite elements;

(3) specifying that the material properties of the finite elements have a particular symmetry;

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(4) calculating a material property matrix [k] based on the relationship {f}=[k]{x} and the specified symmetry, wherein the material property matrix [k] comprises a plurality of values each corresponding to one or more material property coefficients;

(5) comparing each of the plurality of values in the material property matrix [k] to known material properties and, responsive to a match, selecting a corresponding manufacturing process parameter, wherein the selected manufacturing process parameter is usable for controlling composite manufacturing equipment if the matched known material property is a material property for a composite material; and

(6) controlling the composite manufacturing equipment in accordance with the selected manufacturing process parameters to thereby manufacture the object.

42. The method according to claim 41, wherein the object being manufactured is a prosthetic implant for replacing a body part and the force {f} and displacement {x} are specified based on the in vivo forces applied to the body part to be replaced and the in vivo displacements generated in the body part to be replaced when the forces are applied thereto.

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